



Potential consequences of small size and habitat fragmentation on eastern prairie fringed orchid populations

Lisa Wallace

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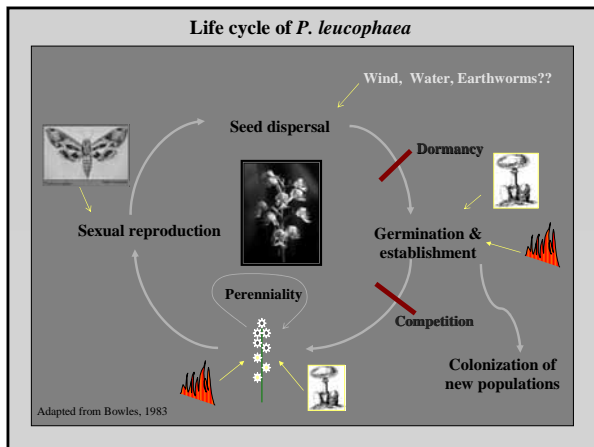
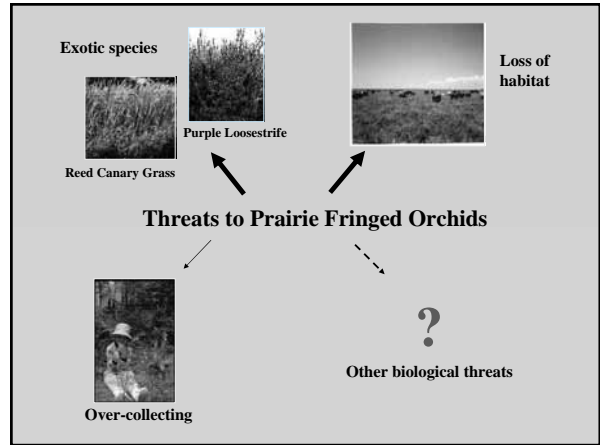
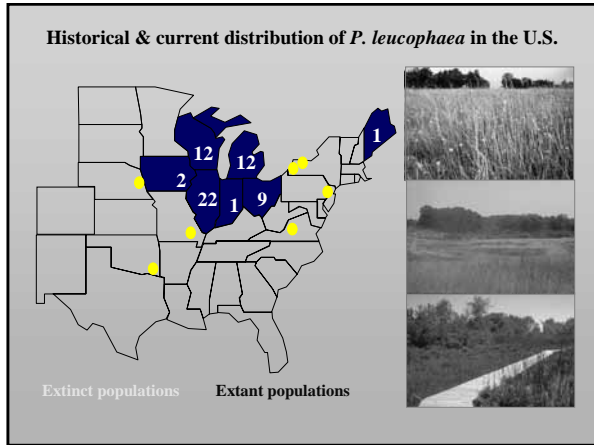
Recovery Needs for *P. leucophaea*

- Manage for population persistence
- Status and management of pollinators
- Population restoration
- Protection against anthropogenic factors



Talk Outline

- I. Ecology of *P. leucophaea*
- II. Genetics & rarity
- III. Reproductive biology & rarity
- IV. Management trends

Platanthera leucophaea
Eastern prairie fringed orchid



P. leucophaea and its pollinators

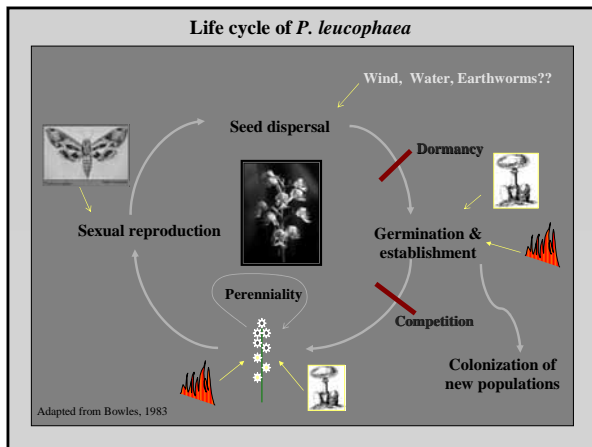
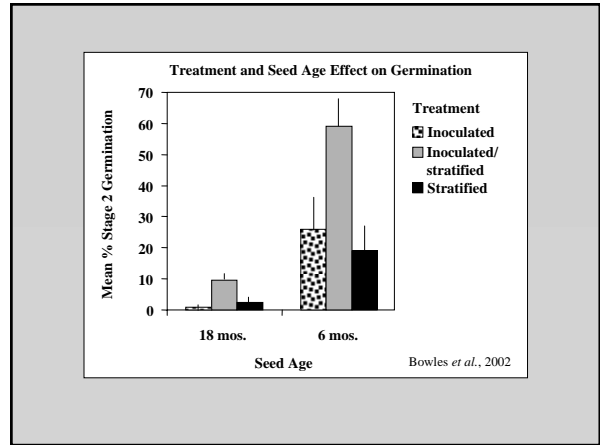
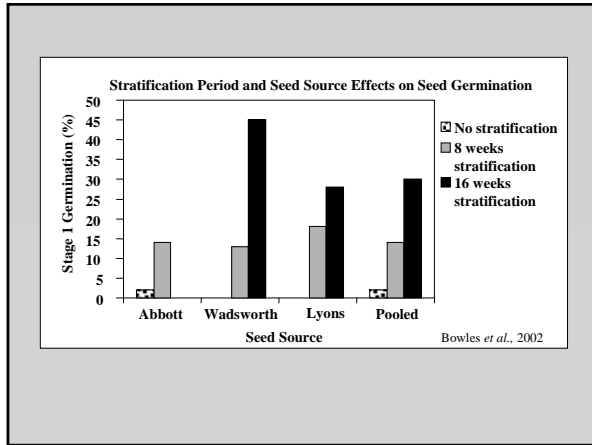
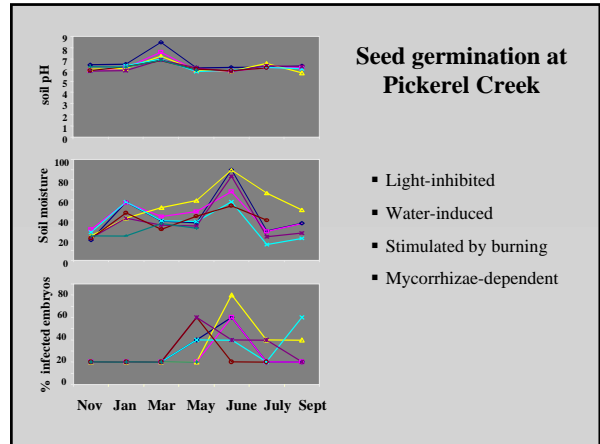
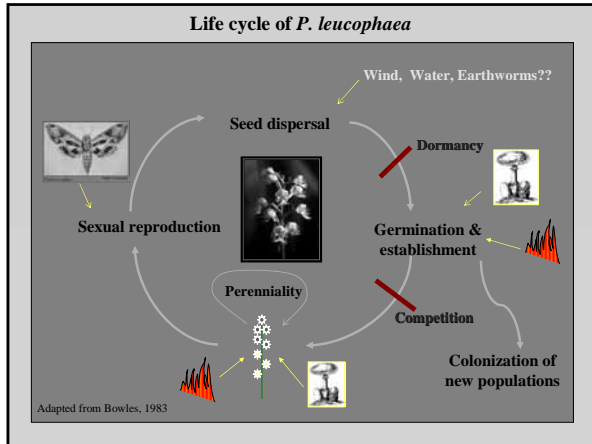



Arctium sp.

Heliothis sp.

Photos from USFWS image library.

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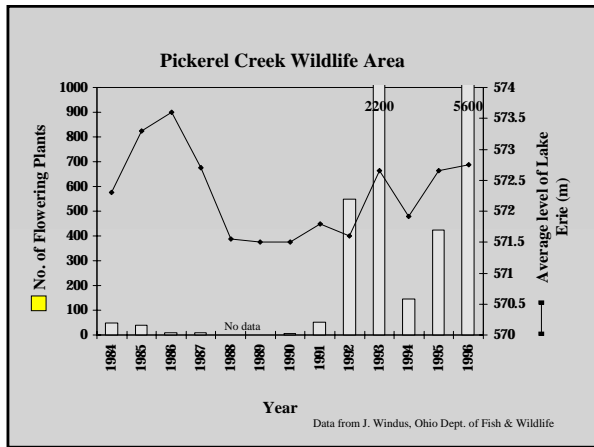
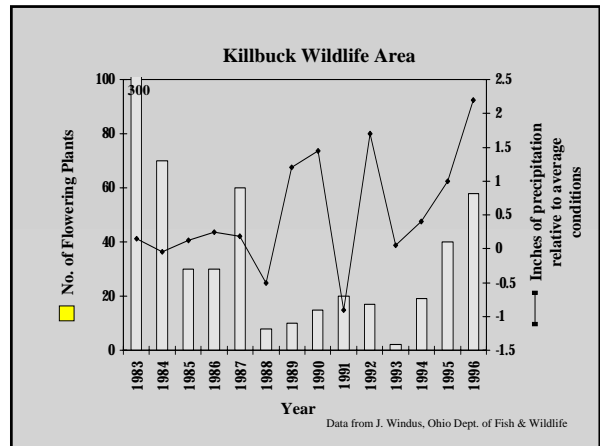
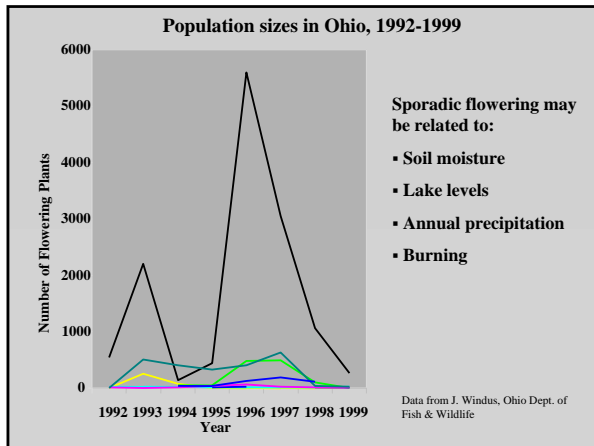
Status of tagged plants in Pickerel Creek Population, 1992-1996.

Plant	1992	1993	1994	1995	1996
801	F	F	NF	NF	F
803	F	F	NP	NP	NP
804	F	F	NF	F	NF
805	F	F	Grzd	NF	NF
806	Grzd	F	Grzd	NF	NF
807	F	F	Grzd	NP	-
808	F	F	NF	NP	NF
809	F	F	Grzd	F	F
810	F	F	Grzd	NF	NF
811	F	F	Grzd	NF	F
812	Grzd	NF	Grzd	NF	NP
813	Grzd	F	NP	NP	NP
814	F	F	-	NP	-
815	F	F	-	NF	F
817	NF	NF	NP	NP	NP
818	F	F	-	F	F
821	Grzd	F	Grzd	F	F

Data from J. Windus, Ohio Dept. of Fish & Wildlife

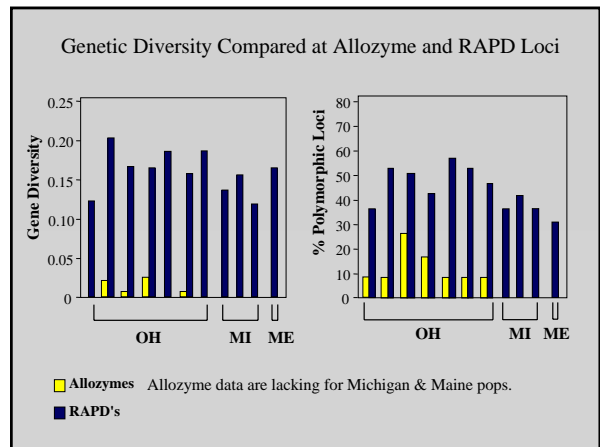
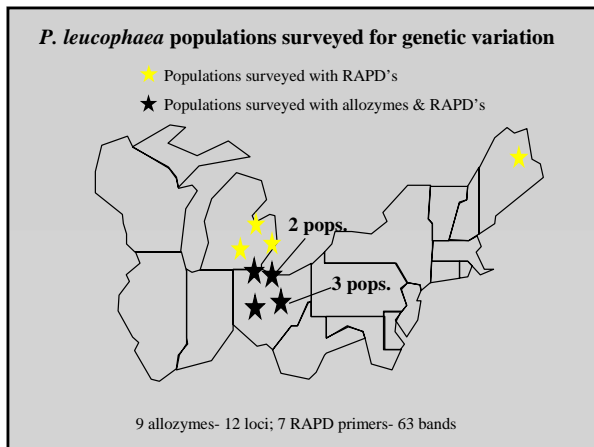
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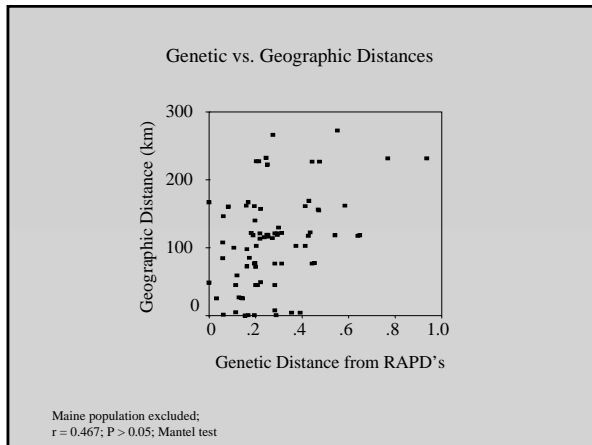
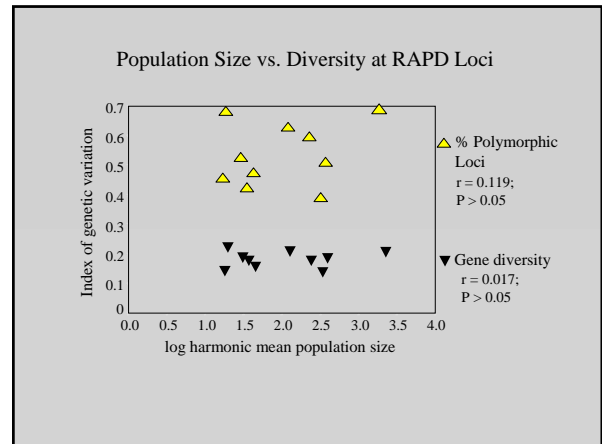
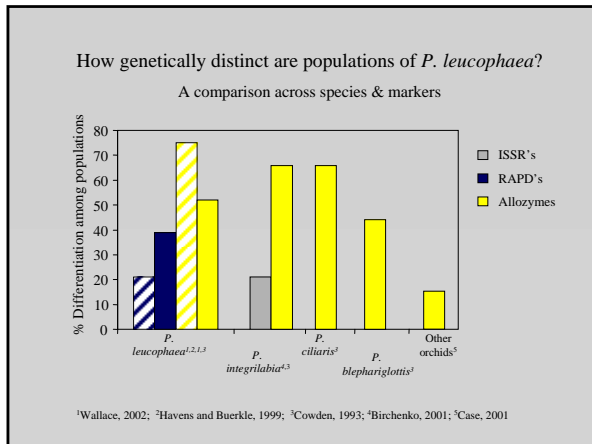
II. Genetics & Rarity in *P. leucophaea*

- How much genetic variation, estimated with neutral molecular markers, is detectable in eastern populations of *P. leucophaea*?
- Are the levels and structure of genetic variation comparable to western populations of the species?
- Is there evidence of fragmentation or small population size in molecular genetic variation?



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Conclusions- Genetic Variation in *P. leucophaea*

Allozymes and RAPD's suggest different levels of genetic diversity in *P. leucophaea*.

Allozyme & RAPD loci follow different evolutionary trajectories

Both data sets also detected significant structure among populations. Is this a consequence of its current rarity or an indication of its ancestry?

Population structure
 Loss of alleles due to genetic drift and/or fixation of alleles in isolation

Population history
 Founder effects and associated loss of diversity
 Origin from divergent source populations and fixation of alleles

Is reduced genetic variation likely to lead to population extinction?

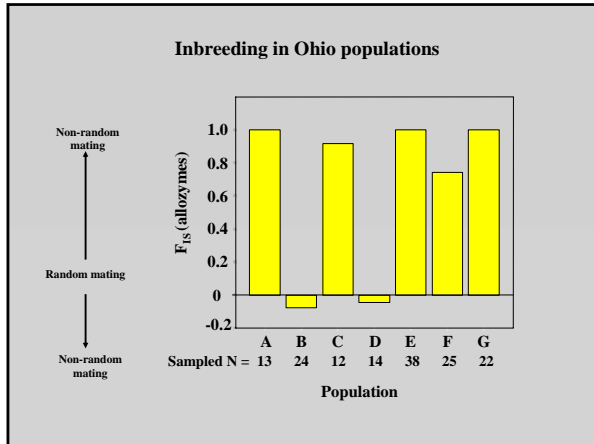
Are these results useful to the preservation of this species?

Yes, they are useful because...

- They demonstrate the importance of using multiple criteria to judge the worthiness of populations for preservation.
- The finding that diversity is not correlated with population size is, perhaps, a positive indication that genetic diversity can be maintained in smaller populations.
- The identification of genotypic patterns provides a baseline for managers, should they wish to experimentally augment populations.

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Outcrossing & inbreeding in *P. leucophaea*

Outcrossing is promoted by:

- Sequential opening of flowers
- Delayed bending of pollinaria
- Pollinator behavior
- Inbreeding depression in offspring

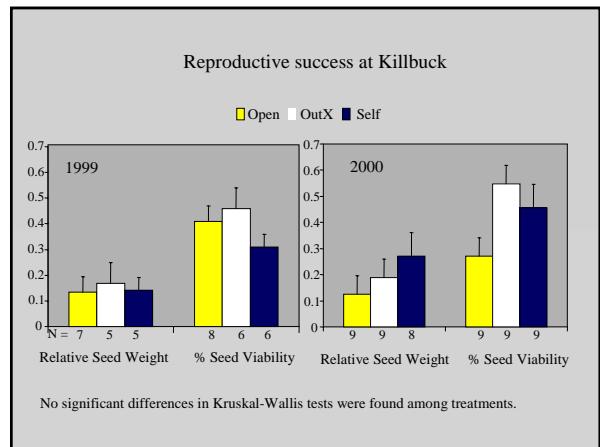
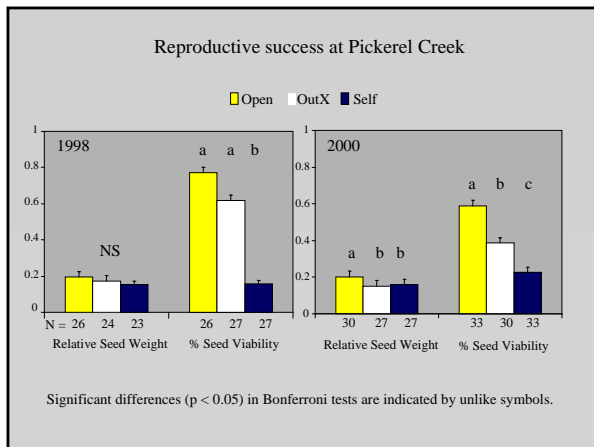
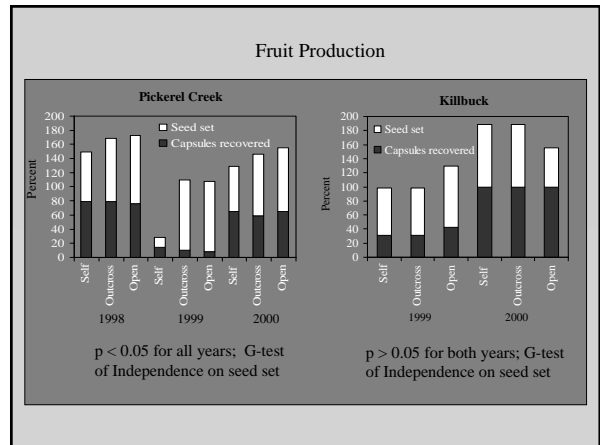
Inbreeding is possible through:

- Geitonogamy
- Mating between closely related genets

~ 40 sec

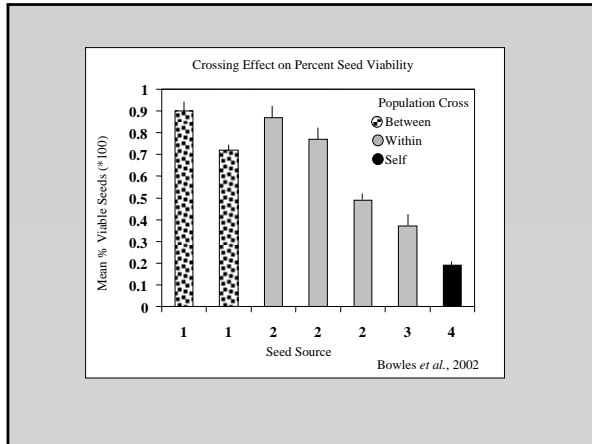
III. Reproductive Biology of *P. leucophaea*

- Sites**
 - Pickrel Creek Wildlife Area (large N, high F_{IS}), repeated 1997-1999
 - Killbuck Wildlife Area (small N, low F_{IS}), repeated 1998-1999
- Pollination treatments**
 - Outcross Self
 - Open No pollination
- Variables**
 - Seed set
 - Relative seed weight
 - Seed viability



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Inbreeding Depression Compared Across Estimators

IBD = (outcross – self)/outcross

Population, year	Seed set	Relative seed mass	Percentage of viable seeds
Pickerel, 1998	0.21	0.12	0.74
Pickerel, 2000	0.26	0.05	0.42
Killbuck, 1999	0	0.17	0.49
Killbuck, 2000	0	0.03	0.17
	Seed production	Seed germination	Overall
Selfing angiosperms	0.03	0.04	0.23
Outcrossing angiosperms	0.19	0.15	0.53

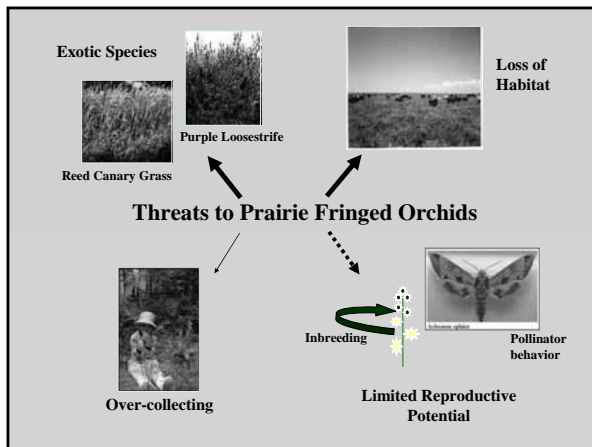
Husband & Schemske, 1996

Conclusions – Inbreeding depression

- Early acting inbreeding depression is possible in *P. leucophaea*, although the magnitude of IBD can vary temporally and across populations.
- Higher levels of seed set among open-pollinated capsules at Pickerel Creek compared to Killbuck suggest that smaller populations may be pollinator-limited.

Is inbreeding depression a significant threat to this species?

- Geitonogamy and matings between related genets allow for inbreeding.
- Allozyme data suggest that inbreeding happens.
- Selfing is likely to lead to fewer viable seeds.
- So, inbreeding depression could negatively impact populations, but.....
- Each flower is capable of producing thousands of seeds, some of which will likely be viable.



IV. Current Management Trends

- Preserve habitat and size of extant populations
 - Maintain natural hydrologic cycles and removal of drainage tiles
 - Shrub and invasive species removal by cutting, herbicides, fire
 - Maintain habitats that are ecologically diverse to allow orchids to retreat during years of high lake levels
- Use of fire to promote flowering
- Hand-pollination of plants
- Restoration in protected prairie remnants
- On-going demographic monitoring
- Continued research
 - Demographic costs of hand-pollination
 - Potential for outbreeding depression
 - Measures to control invasive species with minimal harm to the orchids
 - Seed germination and survival within populations



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Similarities

- Evolutionary history
- Habit
- Method of reproduction
- Environmental threats
- Habitat requirements (i.e., need for periodic disturbance)

Differences

- Narrow endemism of *Piperia yadonii*
- Different ecological niches
- Population sizes vs. number and distribution of populations



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